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(71) Applicant: **AKZO N.V.**
Velperweg 76
NL-6824 BM Arnhem(NL)

(72) Inventor: **Durand, Dominique**
18, Rue des Frères Kennedy
F-91580 Etrechy(FR)

(74) Representative: **Schalkwijk, Pieter Cornelis et al**
AKZO N.V., Patent Department (Dept. APTA),
P.O. Box 9300
NL-6800 SB Arnhem(NL)

(54) Two-layer coating systems for wheels and architectural applications.

(57) The present invention relates to a two-layer coating system consisting essentially of (a) a first coating layer based on an epoxy resin, alkyd resin, polyester resin, melamine-containing resin, polyurethane resin and/or polyacrylate resin; and (b) a second metallized transparent powder coating layer containing a mica pigment. This two-layer coating system is particularly suited for aluminum substrates such as wheels for cars and in architectural applications.

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The present invention relates to a multilayer coating system which is suitable, e.g., for covering wheels for cars or for use in architectural applications, particularly involving aluminum substrates.

Such coating systems should possess a good combination of properties such as total layer thickness, metallic lustre, stone-chipping resistance, corrosion resistance, petrol resistance and outdoor durability.

Known systems are normally based upon at least three coating layers including a first coating layer which provides generally the basic color and opacifying of the substrate, a second liquid layer which provides a metallized effect and, finally, a third liquid clear varnish which provides certain appearance and protective aspects required for the particular end use. The known systems, however, do not always possess a desired combination of the aforementioned properties and, in addition, the application of so many coating layers can result in technical problems.

It is, therefore, an object of the present invention to provide a two-layer coating system which surprisingly possesses a more desirable combination of the aforementioned properties.

The two-layer coating systems in according with the present invention consist essentially of:

(a) a first coating layer based on an epoxy resin, alkyd resin, polyester resin, melamine-containing resin, polyurethane resin and/or polyacrylate resin; and

(b) a second metallized transparent powder coating layer containing a mica pigment.

The use of this coating system results in a desirable combination of properties such as weatherability, corrosion resistance, stone-chipping resistance and appearance characteristics.

The first coating layer in accordance with the present invention provides the basic color of the two-layer coating system as well as opacifying of the substrate. Depending on the desired end use, the first coating layer may comprise a cathodic electrodeposition coating layer or a powder coating layer based on an epoxy resin, alkyd resin, polyester resin, melamine-containing resin, polyurethane resin and/or polyacrylate resin, such layers and resins being generally well-known in the art.

The second metallized transparent powder coating layer is preferably based upon any one of a number of polyester resins, epoxy resins, acrylate resins and/or polyurethane resins known for use in powder coatings for producing transparent layers, and optionally a curing agent for that resin. Of these, the polyester resins are particularly preferred.

The polyester resin can be a hydroxylated polyester in combination with a hydroxyl group reactive curing agent, but preferably is a carboxylated polyester in combination with a carboxyl group reactive curing agent. A very suitable powder coating system for the second layer comprises a carboxylated polyester and an epoxy compound as curing agent.

Suitable polyesters can be obtained via customary preparation processes from by preference substantially aromatic polycarboxylic acids and a variety of polyols.

As aromatic polycaboxylic acids may be mentioned phthalic acid, isophthalic acid, terephthalic acid, pyromellitic acid, trimellitic acid, 3,6-dichlorophthalic acid, terechlorophthalic acid and, in so far as available, the anhydrides, acid chlorides and lower alkyl esters thereof.

In addition to the aromatic acids, cycloaliphatic and/or acylic polycarboxylic acids may be utilized in amounts up to 30 mol%, and preferably up to 20 mol%, based upon the total moles of carboxylic acids utilized. As examples of cycloaliphatic and/or acyclic polycarboxylic acids may be mentioned tetrahydrophthalic acid, hexahydroendomethylene tetrahydrophthalic acid, azeleic acid, sebacic acid, decanedicarboxylic acid, dimeric fatty acids, adipic acid, succinic acid and maleic acid. Hydroxycarboxylic acids and/or lactones such as 12-hydroxystearic, ϵ-caprolactone and the hydropivalic acid ester of neopentyl glycol, as well as monocarboxylic acids such as benzoic acid, tert.-butyl benzoic acid, hexahydrobenzoic acid and saturated aliphatic monocarboxylic acids, can also be utilized in minor amounts.

As suitable polyols may be mentioned aliphatic diols such as ethylene glycol, propane-1,2-diol, propane-1,3-diol, butane-1,2-diol, butane-1,4-diol, butane-1,3-diol, 2,2-dimethyl propane-1,3-diol (neopentyl glycol), hexane-2,5-diol, hexane-1,6-diol and diethylene glycol; and cycloaliphatic and aromatic diols such as 1,4-dimethylol cyclohexane, 2,2-bis(4-hydroxycyclohexyl) propane and 2,2-bis-[4-(2-hydroxyethoxy)phenyl] propane. In addition, smaller amounts of higher functional polyols may also be utilized such as glycerol, hexanetriol, pentaerythritol, sorbitol, trimethylol ethane, trimethylol propane and tris-(2-hydroxy)isocyanurate. Epoxy compounds may also be utilized as polyols. Preferably, the polyol component comprises at least 50 mol% of neopentyl glycol and/or propylene glycol, mol% here being based upon the total moles of polyols utilized.

Using processes known per se the polyesters may be prepared by esterification and/or transesterification, optionally in the presence of customary catalyst such as, for instance, dibutyl tin oxide or tetrabutyltitanate, in which processes, owing to a suitable choice of the preparation conditions and of the COOH/OH ratio, end products are obtained the acid value of which is preferably

between 5 and 150 (mg KOH/g resin), and which are preferably carboxyl group terminated.

As indicated above, the preferred curing agent for the carboxylated polyester is an epoxy compound such as triglycidylisocyanurate or a heterocyclic triepoxy compound, such as methyl-substituted triglycidylisocyanurate or 1,2,4-triglycidyltriazolidine-3,5-dion or diglycidyl-terephthalate or an epoxy resin based on bisphenol A and epichlorohydrin, of which triglycidylisocyanurate is preferred. The amount of epoxy compound utilized depends on the acid value of the polyester resin and on the epoxy equivalent weight of the epoxy compound. Preferably, the epoxy compound is utilized in amounts ranging between 0,8 and 1,2 equivalent epoxy per equivalent carboxyl group.

As also indicated above, the second metallized transparent powder coating layer contains a mica pigment which is responsible for the metallization. Mica is a well known class of minerals. Most micas are predominantly aluminium silicates of potassium, iron, lithium or fluorine. Since the chemical compositions are quite variable, mica may range from colorless and transparent to highly coloured, opaque varieties. According to a preferred embodiment of the present invention, the mica comprises platelets of mica coated with titanium dioxide.

Preferably the amount of mica utilized in the second layer is between 0,5 and 10% by weight based upon the total weight of the second layer.

The preparation of powder coatings based upon carboxylated polyesters and epoxy resins is generally well-known in the art. Preferably, the carboxylated polyesters are mixed via, for example, extrusion and at a temperature of from 110-130 °C, with a polyepoxide, eventually pigments and other additives.

The mica pigment which is responsible for the metallization can be added at different places in the powder coating preparation. The addition can take place as an internal metallization before the extrusion, as an external metallization after grinding or a combination of the external and internal metallization. Peferably the external metallization is used.

Other normal additives such as, for instance, other pigments, fillers, anti-oxidants, colorants, flow-promoting agents, release agents, viscosity agents, levelling agents and UV-stabilizers can be added to the coating systems of the two-layers.

Suitable pigments are, for instance, inorganic pigments such as titanium dioxide, zinc sulphide, iron oxide and chromium oxide, and organic pigments such as azo compounds.

Suitable fillers are, for instance, quartz powder, calcium and magnesium silicates, calcium carbonate, barium sulphate, calcium sulphate and aluminium oxide and mixtures of these optionally with smaller amounts of, e.g., aluminium hydroxide, ammoniumpolyphosphate and the like.

Suitable flow-promoting agents are, for instance, liquid polyacrylates such as, for instance, polybutylacrylate and polyethylacrylate, fluorinated polymers such as, for instance, esters of polyethylene glycol and perfluoroctanoic acid and polymeric siloxanes such as, for instance, polydimethyl siloxane or polymethylphenyl siloxane.

Of course, with respect to the second coating layer these additives should not substantially affect the transparent nature thereof.

The powder coatings utilized for the second coating layer are preferably applied to the first coating layer by electrostatic/tribo spraying and cured at temperatures between 160-200 °C under the influence of a catalyst. During the curing process, the powder coating melts and subsequently flows out to form a smooth, continuous coating film before substantial curing of the components.

Suitable catalysts must guarantee rapid curing of the components but must be substantially inactive in the mixing of the polyester and epoxy resins.

Prior to application of the second coating layer, the first layer can be a cured layer but also a non- or partially cured layer. An advantage of the present two-layer coating system, however, is the possibility to cure both layers in one step, in which case the first layer is applied as a base, over which the second metallized transparent powder coating is applied, after which the total system is cured under the aforementioned conditions.

Preferably the two-layer coating system according to the invention is applied onto an aluminum substrate; however, the system can also be applied on other substrates such as iron, steel, copper, carbon, wood, glass and polymers.

When the two-layer coating system is applied onto wheels for cars, it has been found most advantageous to utilize a cathodic electrodeposition layer as the first layer, especially one based upon an epoxy resin and optional curing agent therefor. Particularly preferred is a cathodic electrodeposition layer based upon an aqueous dispersion or solution of an epoxy resin.

Preferably, the thickness of the cathodic electrodeposition first layer is between 15 and 30 μm, the thickness of the second metallized transparent powder coating layer is between 30 and 100 μm (and more preferably between 40 and 70 μm), and the total thickness of the two-layer system is between 45 and 130 μm (and more preferably between 55 and 100 μm).

When the two-layer coating system is utilized in architectural applications, it has been found most advantageous to utilize as the first layer another powder coating based on an epoxy resin, polyester

resin, polyacrylate resin and/or polyurethane resin, and optionally a curing agent therefor.

This first powder coating layer can contain the already mentioned customary additives, and especially a pigment to obtain a color.

Preferably, the thickness of the first powder coating layer is between 30 and 100 µm (and more preferably between 40 and 70 µm), and the thickness of the second metallized transparent powder coating layer is between 30 and 100 µm (and more preferably between 40 and 70 µm).

This system results in an excellent aspect of the powder layer for architectural uses. Furthermore the adhesion between the two layers is very good.

The invention will be further elucidated by means of the following examples, without, however, being limited thereto.

Example

A wheel was provided with a cathodic electrodeposition layer based on an epoxy resin. Next, a powder coating based on a polyester and TGIC (weight ratio polyester: TGIC 93 : 7) and mica ('Mearlin superwhite') was applied in a weight ratio polyester/TGIC: Mica 95 : 5 by tribospraying in a layer thickness of 45 µm.

Curing conditions: 10 minutes, 180 °C, infrared curing.

The coating system resulted in the following characteristics:

- weatherability (according to the Peugeot method; xenon with 500 hours exposure) : loss of gloss 2%
- salt spray resistance (ASTM B 117) 800 hours: disbonding less than 0,5 mm, no blistering
- stone-chipping resistance (Peugeot method) : 1 (1 = excellent, 2 = very good, whereas 10 = very bad).

Claims

1. A multilayer coating system comprising at least (a) a first layer and (b) a second metallized coating layer, characterized in that the coating system is a two-layer coating system consisting essentially of:
   (a) a first coating layer based on an epoxy resin, alkyd resin, polyester resin, melamine-containing resin, polyurethane resin and/or polyacrylate resin; and
   (b) a second metallized transparent powder coating layer containing a mica pigment.

2. The coating system according to claim 1, characterized in that the mica pigment comprises platelts of mica coated with titanium dioxide.

3. The coating system according to any one of claims 1-2, characterized in that the first coating layer is based on an epoxy resin.

4. The coating system according to any one of claims 1-3, characterized in that the second metallized transparent powder coating layer is based upon a polyester resin and a curing agent therefor.

5. The coating system according to claim 5, characterized in that the polyester resin is a carboxylated polyester resin and the curing agent is an epoxy resin.

6. The coating system according to any one of claims 1-5, characterized in that the first coating layer is a cathodic electrodeposition layer.

7. The coating system according to claim 6, characterized in that the first coating layer comprises a thickness between 15 and 30 µm, the second metallized transparent powder coating layer comprises a thickness between 30 and 100 µm, and the two-layer coating system comprises a total thickness between 45 and 130 µm.

8. The coating system according to any one of claims 1-5, characterized in that the first coating layer is powder coating layer.

9. The coating system according to claim 8, characterized in that the first coating layer comprises a thickness between 30 and 100 µm, and the second metallized transparent powder coating layer comprises a thickness between 30 and 100 µm.

10. A substrate coated with the two-layer coating system according to any one of claims 1-9.

11. The coated susbtrate according to claim 10, characterized in that the substrate is aluminum.

12. A wheel comprising the coated substrate according to any one of claims 10-11.

13. A method of producing the coated substrate according to any one of claims 10-12, characterized in that the first coating layer is applied onto the substrate, the second metallized transparent powder coating layer is applied onto the first coating layer which has optionally been partially or fully cured, then curing the system.

14. The method according to claim 13, characterized in that the second metallized transparent powder coating layer is applied onto a first coating layer which has not been cured.

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EUROPEAN SEARCH REPORT

Application Number

EP 92 20 2190

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP-A-0 186 607 (INMONT CORP.) * claim 1 * * page 4, line 9 - line 21 * * page 4, line 28 - page 5, line 2 * * page 11, line 23 - line 29 * * page 15, line 1 - line 9 * ---	1,2,4, 10,11	B05D5/06 C09D5/03
A	DE-A-3 814 853 (KANSAI PAINT CO.) * claims 1,13,14 * ---	1	
A	DE-A-3 324 726 (BOSCH-SIEMENS HAUSGERAETE) ---	1	
A	DE-A-1 769 867 (METALLGESELLSCHAFT AG) -----	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B05D
C09D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 NOVEMBER 1992	GIRARD Y.A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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